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LOCAL SCIENTIFIC SOCIETIES AND THE COMMUNITY[1]

By Dr. HERBERT L. HAWKINS

PROFESSOR OF GEOLOGY, UNIVERSITY OF READING

THROUGH the whole range of nature, classification shows an underlying simplicity of principle expressed through various materials and in diverse grades. Gravitation controls galaxies and sand-grains, and evolution is the common destiny of genera and of individuals. Both of these fundamental principles tend inevitably to pile up aggregates of ever-increasing size and complexity. But such aggregates are collections of units, and, while appearing to acquire new properties, remain subject to the laws that govern units and dependent on the reaction of their components to those laws.

Human nature, despite the bombastic claims often urged by its exponents, illustrates the operation of the principle of evolution with painful fidelity, especially in its social reactions. From the lone hunter through the clan to the totalitarian state the process of aggregation goes on, with increasing complexity and decreasing flexibility, until Nemesis clears the stage for the next performance. Within the frame of natural or imperial unification are innumerable smaller aggregates, each so similar in type to the whole that one is reminded of a crystalline fabric, where each molecule has a shape consistent with that of the complete crystal.

A scientific society is but one example of this tendency towards congregation of kindred types. Whatever may be its peculiarities, its success or failure, each society has originated in much the same way as all the others. In most cases, its history can be traced back to the enthusiasm of an individual, who has attracted

[1] Address of the president of the Conference of Delegates of Corresponding Societies at the British Association for the Advancement of Science, Dundee, 1939.

and stimulated a small coterie of friends or disciples. Organization has followed; and, whether it was invented or adapted from previous models, it has produced a miniature copy of a democratic state, complete with cabinet and treasury.

The aims of these societies vary somewhat, some being devoted to research, others to instruction. The former type of society is in constant danger of decline, for it needs continuous stimulation by new enthusiasts in successive generations; the latter is fortunate if it avoids the comatose senility of a social club.

Sociability is, however, the key to the success, and almost a *raison d'être,* of a local society. Unless this is an association of friends, it belies its name and loses its efficiency. It is not in the academic eminence of its members, but in the spirit of cooperation and enjoyment, that the value of the society lies. For this reason a society that organizes field-excursions as an essential part of its program is a far more lively institution than one where the members meet only in the enforced silence of a lecture-hall. The element of friendly intercourse may, naturally, degenerate into a mere picnic; but even that is preferable to the priggish snobbery of a lion-hunt.

A society attracts to membership others besides those whose natural enthusiasm marks them as leaders in its enterprise. Although the danger of over-emphasis of the social side may be thus increased, such recruits are to be welcomed. Some may become interested and inspired, but all will contribute something, be it only a subscription, to help the society's work. No government can hope to carry out its schemes without the backing of a body of reasonably willing tax-payers.

The present is not altogether a propitious period for the advance of local societies. Although the proportion of the population capable of appreciating the aims of the societies is perhaps greater than formerly, the increase in the opportunities for recreation tends to reduce the personnel for any particular form of activity. Its local character is an essential aspect of a local society, and the metropolization of the provinces by transport and wireless telephony has obliterated much of the individuality of districts. Most societies deplore the lack of youthful recruits, and look forward with anxiety to decreasing membership.

In the great majority of cases, the members of local scientific societies are "amateurs" in the generally accepted sense of that term. Their scientific work is their hobby; and in the present pressure of business life few have time or energy to spare for a pastime that demands intellectual effort. The young prefer forms of recreation that involve strenuous and often exhausting physical exercise, while the middle-aged tend towards somnolent recreation. Not until retirement ensures leisure for following their own devices can most business men undertake the responsibilities or even enjoy the privileges of active membership. To such, a scientific society may offer hope of survival and of congenial activity, beyond the critical phase at which it used to be customary to receive an inscribed clock to mark the last few hours of life. Local societies can confer benefit on these and on themselves by attracting them to membership. Individually they may have poor actuarial prospects of permanence; but as a class they are available in ever-increasing numbers.

Probably the most fatal disease that can overtake a local society is that which gives it a reputation for erudition. If there is any truth in the fear of a prospective member that he or she would feel ignorant in a company of savants, membership should be avoided at all costs, for the society is not worth joining. Interest, not intellectual, should be the gauge of suitability; humble inquiry is more appropriate even to the specialist than declamation of a learning that is only ignorance in disguise. Mutual sympathy and encouragement must be the spirit of the society; all are there to learn, and no teacher needs to be reminded that he learns at least as much from contact with keen students as they are likely to learn from him.

So much of the useful work and maintenance of interest in scientific matters depends on casual everyday observation, that aspects of nature ready to hand for the majority of members are likely to receive and give most satisfaction. A society in a coastal town can obviously foster the study of marine conditions that would be outside the practical scope of one in a midland industrial city. While retaining an intelligent curiosity in respect of any and every thing in the universe, a healthy local scientific society will normally tend to focus its main efforts on locally appropriate topics. In this matter, the term "locally" may apply to some especially vigorous member, whose enthusiasm for his particular bent infects many of his colleagues, and, for his generation at least, overshadows the milder activities of those who have escaped contagion. Such waves of fashion are perhaps inevitable; but they are not altogether desirable. Hero worship falls very flat when the hero proves mortal.

Most local societies are devoted to "natural history"; very few take much cognizance of the physical sciences. When specialization is made, the two subjects of geology and archeology are those usually selected. Evidently the main function of a local society is its provision of relaxation for people who have no technical training in science. Outdoor interests offer far healthier spare-time hobbies than laboratory studies where elaborate calculations or stiff reading give no respite to jaded minds. An attractive feature of the natural sciences is the scope they afford for the making of collections. From early childhood the jackdaw-complex is deeply ingrained in most of us; and although specimen-collecting may become a vice, it shares that

risk with all other virtues. So long as mere miserly acquisitiveness is avoided, the arrangement and study of collected material can revive memories of past thrills and prolong the joys of field-work. This matter of collections is so important that it may be discussed somewhat fully.

An important duty of every scientific society should be the control, by precept and example, of the mania for collecting. Especially in the case of living things, due regard for the preservation of rarities must check wholesale destruction. It is pleasing to be able to record a great improvement in this respect achieved in recent years, largely through the influence of local societies. The days when a rare plant or animal was ruthlessly slaughtered in the name of science are past—even game-keepers (who are rarely members of our societies) are less promiscuous in their attacks on any creatures worth preserving. We are even beginning, with the inspiration of the Council for the Preservation of Rural England and the National Trust, to frown upon, rather than to condone, vandalism done in the sacred name of Mammon.

But there yet remains ample scope for the training of collectors; and almost every society is likely to include some members who can guide and counsel the uninitiated. Collection involves dissociation of the specimen from its natural environment; in the majority of cases that environment is one of the most informative features of the specimen. It can not be brought away in substance, but it should always be recorded in writing with all possible detail. Paradoxical though it sounds, it is nevertheless true that a collection of specimens without adequate labels is less useful than a collection of labels without specimens. Every particular of the circumstances attending the collection of the specimen should be written down at the actual time and place—memories get blurred at the end of a day. Even details that seem irrelevant should be noted; wider experience may show that just such points had the greatest significance.

If all the material that clutters up our museums had been collected in accordance with that simple principle, its value for scientific research would have been enhanced a thousandfold; the charnel-house would have been a biographical library. One battered fragment with a history is worth a score of "plums" without a label; for there is more satisfaction in scientific circles over one poor specimen with particulars attached than over ninety-and-nine perfect examples that have no such accompaniment.

In the matter of collecting, the local society has no need to encourage an inborn instinct, but rather should guide and restrain. A collection made for a definite intellectual purpose is unlikely to lead to decimation of its materials. But the collecting of specimens is really a pandering to low instincts; a far more important and fruitful activity is the collecting of facts. Except when they are needed to substantiate a record or are required for intensive research, objects observed are often better left where they are. This policy of restraint does not apply to inanimate objects, which may be preserved by being taken under cover; but in the case of living things it is unusual, and surely unnecessary, to prove that one has met a friend by bringing his corpse home as a witness.

In the matter of research, the greatest contribution (other than encouragement) that can be made by scientific societies comes from their ability to keep, check and publish records of transient phenomena. Every recurrent seasonal event in nature invites, and often receives, accurate observation. Whether it be the first cuckoo or the last swallow, the flowering of the primrose or the ripening of the holly, it is apt for and deserves a permanent record. In such work the society, as distinct from the individual, has a special value; for records without independent confirmation are of uncertain use. Moreover, a record, however well authenticated, of a single phenomenon gains immeasurably in importance when taken in conjunction with other records of contemporary events. The dates of appearance and disappearance of living creatures are shorn of half their significance without statistics of the weather for the season. The arrival of a migratory bird in any district may prove to be controlled by the appearance of a particular insect, and this again may depend on the growth of the insect's food-plant, which may have been determined by the weather-conditions of the current or past season. The keeping of statistics thus becomes a matter of team-work; ideally every natural history society should include observers who keep accurate and unbroken records of data on every conceivable topic capable of such treatment.

Accurate prophecy is always based on knowledge of past history correlated with a perception of the laws of cause and effect. Statistical records such as those indicated would provide the raw material of prophecy; if such truly natural history of but a few decades were available, it would aid in forecasting just those tantalizing mysteries that every farmer, and so every consumer, wants to know. Just as a straw shows the way of the wind, so some obscure animal or plant might, if its significance were realized, provide an answer to problems of immense practical importance. The most sophisticated social order depends ultimately on nature, and common sense demands that the foundation of the social fabric should be studied. There is endless useful research awaiting the efforts of local observers in this indirect aspect of man's place in nature.

As regards geological and archeological studies, there can surely have been no period in the past more favorable than that in which we find ourselves to-day.

For one reason or another, excavation is a dominant feature of our present activities; and, however shallow it may be, every hole is likely to reveal something of interest. Modern methods of excavation are so speedy and mechanized that much of their revelations can be observed only by perpetual watching. Here the local society can find scope for important and urgent work. Every society should acquire a large-scale map of its area, and plot on it every site where a glimpse, however fleeting, of the subsoil has been possible. Pin-pricks on the map, with numbers written against them, to correspond with card-index entries giving all the particulars, would soon make the map a priceless record. Only accuracy and persistence are wanted to achieve results that could not fail to increase the knowledge that all local societies are nominally out to acquire. Probably most societies include one or more members with the business experience needed to keep the records in order, and every member could contribute to them directly or indirectly. The volume of local knowledge already stored in the minds of residents is impressive; if that knowledge were to be methodically recorded, it would outlive its original possessors and so contribute to something more permanently satisfying than reminiscent causeries.

The suggestions for activity outlined above may seem to be more concerned with the relation of scientific societies to science than with their reaction on the community at large. Such a view is not only narrow, but out of date. In the present critical times, statistics of the resources and character of the country are being feverishly compiled. There could surely be no better compilers than those residents in any district who have trained themselves to observe facts and to tabulate them methodically. Such problems as the yield of springs and wells, the availability of road-metal, sand and gravel, the quality of the soil, the incidence of blight and the usefulness or otherwise of our fellow inhabitants, are all of a nature that demand accurate observation on the spot. Many of them may involve elaborate technical study as well; but the first stage of all of them is within the capacity of any reliable observer. All who love their country (in both senses of the word) can find here congenial and valuable work that is needed urgently.

The proportion of the population likely to join, and participate in, a scientific society is inevitably small; but that is no reason why it should not serve as a leaven. The study of natural history produces a philosophic outlook that should supply a much-needed corrective to the world, and can mitigate the worst attacks of the flesh and the devil. The mere existence of a company of people declaring their interest in matters bigger than the squabbles of the political nursery, preferring to contemplate wider problems and vistas than those of the daily headline, should be enough to ensure a nucleus of stability in the quicksands of opportunism. Science is a search after the truth; its devotees should be sure of their gospel, and declare it in a world of falsehoods: ***Magna est veritas, et prevalebit.***

WHERE DO METEORITES COME FROM?[1]

By Professor C. C. WYLIE

STATE UNIVERSITY OF IOWA

SINCE the days of Schiaparelli and H. A. Newton, astronomers have considered three possible answers to the oft-repeated question, "Where do meteorites come from?" The three answers considered are: (1) that they come from the distances of the fixed stars; (2) that they come from the outer portions of the solar system, like most comets; and (3), that, like the closer asteroids, they have been traveling in orbits little larger than that of Mars.

Schiaparelli and others were impressed with the fact that the great majority of velocities as determined for the meteors dropping meteorites were high. They were so high that, if real, the meteors must have come from the distances of the stars. H. A. Newton, however, found that most meteors dropping meteorites came from the general direction of the anti-apex of the earth's motion. That is, before the meteors entered the earth's gravitational field, they had been traveling in the same general direction as the earth itself. This indicated that the meteors had been traveling in orbits little larger than the orbit of the earth, so Newton and others suspected that the high velocities found for bright meteors were fictitious.

When meteor work was instituted at Iowa some twelve years ago, it appeared that greater accuracy in the paths and velocities for spectacular detonating meteors was needed. To attain this greater accuracy, measurements of the angles and durations have been secured by personal interviews. The observer is asked to stand exactly where he was when the meteor was seen, and the angles are measured as he points them out. If there was definite action at the time of the fall of the meteor, he is asked to "reenact the scene," and the duration is determined with a stop-watch.

[1] Condensed from a paper presented before the American Astronomical Society at Berkeley, California, August 9, 1939.

This work has shown that the estimates received from the general public on spectacular meteors are subject to large systematic errors, which make the velocities much too high. If a sufficient amount of information is at hand, however, a person familiar with these psychological errors can eliminate most, and determine a path reasonably close to the truth, even from the information received by letter. Some of the more famous meteors of years ago have been studied in the light of this information.

Orbits have been calculated recently for a number of spectacular meteors; and six have been selected as representative. The first four are recent ones falling in the middle western United States, for which the paths and velocities are based on personal interviews, as explained above. The four meteors selected fell in the months of August, July, January and November, respectively. Numbers (2) and (3) fell in the evening hours, number (4) fell in the early morning hours just before dawn, and number (1) dropped meteorites in broad daylight.

The fifth meteor, which fell on February 9, 1913, in Canada, was selected because it is referred to as one whose path through the atmosphere was several thousand miles long. The information collected by Professor C. A. Chant, however, was sufficient to determine a reasonably accurate path, whose length was calculated as 116 miles.

The sixth meteor, which dropped meteors at Pultusk, in Poland, on January 30, 1868, was selected because it is referred to as coming in from the distance of the fixed stars. Dr. J. G. Galle, the discoverer of the planet Neptune, collected a great amount of material on this meteor. From this information we have calculated the elements of the orbit.

Table 1 gives for the orbits of the six representative bright meteors, the period in years, the mean distance from the sun in millions of miles, the inclination of the orbit to the orbit of the earth and the eccentricity.

TABLE 1

	(1)	(2)	(3)	(4)	(5)	(6)
Period in years..	1.87	1.70	1.92	3.59	1.62	2.37
Mean distance ..	141	133	143	217	128	165
Inclination	7°.6	1°.9	7°.0	0°.9	17°.5	0°.8
Eccentricity	0.47	0.36	0.55	0.78	0.33	0.46

For comparison we give the same information in Table 2 for three of the closer asteroids.

TABLE 2

	Adonis	Eros	1932 HA
Period in years	2.55	1.76	1.80
Mean distance	173	135	137
Inclination	1°.4	10°.8	6°.4
Eccentricity	0.76	0.22	0.56

In Table 3 we give also this information for Encke's comet, which has the shortest period of any known comet, and for Halley's comet, which has the shortest period of any bright comet.

TABLE 3

	Encke	Halley
Period in years	3.3	76.4
Mean distance	205	1670
Inclination	12°.9	162°.3
Eccentricity	0.85	0.97

For an object coming from the distance of the fixed stars, the hypothesis favored by Schiaparelli and some later astronomers, the period would be millions of years (or infinity), and the eccentricity would be 1.00 or greater.

A comparison of the values shows that the orbits of these bright meteors resemble the orbits of the nearer asteroids much more closely than they resemble the orbits of the closer comets. Obviously, none came from the distance of the fixed stars or even from the distance of the average comet.

SCIENTIFIC EVENTS

THE NEW FISHERY RESEARCH LABORATORY IN PUERTO RICO

METHODS for the development of a modern fishing industry in Puerto Rico, which at present imports about 90 per cent. of the cured and canned fish used in local consumption, will be sought, according to *The Fishery Service Bulletin*, through scientific research by the U. S. Bureau of Fisheries.

With recent tabulations indicating that about 36,000,000 pounds of cured and canned fish are imported into Puerto Rico annually, it is obvious that many new avenues of employment would be provided if the fisheries industries of the island were expanded.

Preliminary plans call for the construction of a new $25,000 laboratory building on a site yet to be selected, where special studies may be made of fish preserving and marketing problems confronting not only Puerto Rico, but also the Virgin Islands and the Latin-American republics.

Situated at the "cross-roads" between North and South American waters and as the result of recent investigations by the President's Educational Commission on Puerto Rico, the new laboratory is designed to serve as the focal point for all fisheries research in the tropical areas.

Benefits from the research work of the laboratory

will be made available to Latin-American republics through a program of cooperation being worked out with the Puerto Rican Government's fisheries division and educational institutions. Under the plan, student assistants will be employed in the laboratory investigations, and, after two years of research work, should be in a position to aid their own governments in solving fisheries problems. As a result, the studies, covering the development of methods for preserving and marketing fishery products, as well as biological and fish cultural investigations, are expected to contribute to the economic welfare of all the Latin-American countries.

Construction of the new laboratory building in Puerto Rico was made possible by a recent grant of Public Works Administration funds.

THE EXPEDITION TO WESTERN COLORADO OF THE FIELD COLUMBIAN MUSEUM

A NUMBER of important fossil finds of the Field Museum Paleontological Expedition to Western Colorado have been reported by Bryan Patterson, assistant curator of paleontology.

These include a skeleton of a prehistoric animal called Taeniodont, a representative of a small early group of hoofed mammals—a forerunner of a similar but larger creature excavated by Mr. Patterson in 1933 and known as Barylambda. The present specimen, according to Mr. Patterson, may constitute a new genus. He writes: "We have been on the track of this beast since 1932, but until now have never found more than a few fragments of it."

Other specimens collected by the present expedition include multituberculates (a group of small rodent-like animals characterized by many cone-like prominences on their teeth) and prehistoric turtles. Work has been begun on the excavation of a fossil crocodile, and a large collection of small fossil animals has been made.

Mr. Patterson is accompanied by James H. Quinn, a member of the staff, and by several volunteer collectors. The official announcement states that

> The field of operations lies in Mesa, Garfield and Gunnison counties, where an extensive series of formations belonging to various periods and eras in the earth's history is exposed. The work is mainly in late Paleocene and early Eocene deposits (the opening epochs of the Age of Mammals), with some attention also being paid to the late Cretaceous formations (the closing period of the Age of Reptiles). The main objective of the expedition is to collect fossil mammals from the Paleocene and Eocene. Specimens from these early horizons are of great interest to students of mammalian evolution. The dinosaurs and other reptiles that had previously dominated the earth were but a short time extinct (geologically speaking), and the mammals were just getting well under way. Many groups that no longer survive were flourishing, and several of the dominant mammalian types of the present time were represented by exceedingly primitive ancestors. Thus, for example, the horses of the early Eocene were small creatures no larger than foxes, and they possessed four toes in contrast to the modern horse's one.
>
> In addition to the work on vertebrates, attention is being given to geological observations and to the collecting of fossil plants. It is hoped that by means of the latter it will be possible to make somewhat more precise age determinations and correlations of the late Cretaceous formations than has hitherto been done.

HURRICANE WARNINGS OF THE U. S. WEATHER BUREAU

THE U. S. Weather Bureau has issued a statement describing the methods used to chart storms during the hurricane season, which in the United States runs usually from July to October.

The hurricane warning service, according to F. W. Reichelderfer, chief of the bureau, is more efficient this year than ever before. Observations are taken twice daily from over eighty stations in the West Indies and the Caribbean, and two to four times daily from vessels in the Gulf of Mexico, Caribbean and West Indian waters. These observations are in addition to the reports from the regular system of stations in the United States and vessels in the North Atlantic.

Whenever there are indications that a tropical cyclone or hurricane is forming, special observations made at two to three hour intervals by ships and stations in the region of the hurricane are sent in so that the four forecast centers of the hurricane warning system—Washington, Jacksonville, New Orleans and San Juan—have information as to the location of the hurricane and its intensity long before it enters American waters or approaches the coast.

The effectiveness of this system was demonstrated recently in the case of the small hurricane which crossed the Florida Peninsula on August 11 and 12. This hurricane was first detected and warnings issued from the Jacksonville center on August 8 when it was located 175 miles northeast of San Juan. Subsequent advisory information was issued every six hours until the storm neared the Florida coast, after which the advices were increased to hourly broadcasts by radiophone until the storm passed across the Peninsula into the Gulf of Merico.

Mr. Reichelderfer points out that:

> These advices serve as examples of the remarkable accuracy with which the movement and intensity of violent storms can be foretold by means of the hurricane warning system. Many studies have been made of the formation and behavior of hurricanes which have moved toward our Atlantic and Gulf coasts during the past fifty years or more. Severe hurricanes do not often reach our coasts. But the Weather Bureau, through its system of hurricane

reporting stations and vessels which serve as outposts to detect and report the approach of a hurricane, is prepared to plot the position of these storms on the weather map long before they approach the coast and to give ample warning of the time of their arrival and their intensity.

As a further aid in insuring that the public will receive ample warning in the rare chance that a severe hurricane occurs this year, the bureau now has available a larger number of stations to make upper air soundings than ever before and is extending its dissemination of hurricane information and warnings by the installation of direct wire teletype connections at the larger population centers and is putting into effect special broadcast arrangements for weather warnings. Upper air observations are an important aid in calculating the direction and speed of movement of hurricanes from day to day.

THE MASTER OF SCIENCE DEGREE IN ENGINEERING OF COLUMBIA UNIVERSITY

COLUMBIA UNIVERSITY has established a new master of science degree in engineering to enable candidates to obtain a broad background without specializing in one department. The degree was established chiefly for practicing engineers in the metropolitan district whose background and technical interests cross departmental lines. Before the introduction of the new general curriculum, it was necessary for graduate students to specialize in either chemical, civil, electrical, industrial or mechanical engineering.

Professor Joseph W. Barker, dean of the School of Engineering, announces that thirty-seven practicing engineers will supplement the instruction given by members of the faculty in fifty-seven courses, which will be given in the Extension Division of the university during the 1939–1940 academic year.

A course in physics, on "The Theory of Heat Conduction," has been added to the engineering curriculum, under the direction of Dr. Melvin Avrami, as part of a plan calling for an increase in scientific subjects dealt with from an engineering viewpoint. Other courses in heat transfer will be given under the direction of Professors C. E. Lucke and C. F. Kayan, of the department of mechanical engineering.

Four courses of an advanced nature have been designed particularly for engineers engaged in industrial activities who do not wish to work towards a degree. A sequence of three courses in electrical engineering has been arranged for students who have had a limited amount of training and who wish to obtain a background in the field. The application of chemical principles in the major chemical industries and the design of chemical equipment will be studied in two courses. Nine other courses will be given in the department of chemical engineering, two of which deal with the chemistry of textile processing. The department of civil engineering has planned fourteen courses, and the department of electrical engineering twelve courses covering every major sphere of electrical engineering.

The department of mechanical engineering will sponsor two courses in air conditioning, and will offer work in fluid dynamics, lubrication and power analysis. "Nomographic Charts and Empirical Equations" will be taught in a special course arranged for engineering students. Studies in engineering and architectural drafting will also be conducted.

Classes in the Extension Division will be held in the late afternoon, evening and on Saturday mornings in order that practicing engineers may enroll.

EDITORS OF THE PUBLICATIONS OF THE AMERICAN CHEMICAL SOCIETY

AT the Boston meeting of the American Chemical Society Professor A. B. Lamb, of Harvard University, was reelected editor of the *Journal* of the American Chemical Society with associate editors as follows: Dr. C. S. Hudson, of the National Institute of Health, Washington, D. C.; Professor Lee Irvin Smith, of the University of Minnesota; Dr. Edward Mack, Jr., of Battelle Memorial Institute, Columbus, Ohio; Dr. R. H. F. Manake, of the National Research Council, Ottawa, Ontario, Canada; Professor Frederick G. Keyes, of the Massachusetts Institute of Technology.

Professor E. J. Crane, of the Ohio State University, was reelected editor of *Chemical Abstracts*. Dr. Harrison E. Howe, of Washington, D. C., was reelected editor of *Industrial and Engineering Chemistry*. Professor N. H. Furman, of Princeton University, and Professor I. M. Kolthoff, of the University of Minnesota, were reelected to the advisory board of the analytical edition of *Industrial and Engineering Chemistry*.

Professor W. Albert Noyes, Jr., of the University of Rochester, N. Y., was reelected editor of *Chemical Reviews*. Professors Robert C. Elderfield, of Columbia University, and E. R. Gilliland, of the Massachusetts Institute of Technology, were elected associate editors.

Professor Farrington Daniels, of the University of Wisconsin, and Professor Herbert Freundlich, of the University of Minnesota, were elected associate editors of the *Journal of Physical Chemistry*. Professor William T. Read, of Rutgers University; Dr. Charles A. Thomas, of Monsanto Chemical Company, Dayton, Ohio, and Dr. Bruce K. Brown, of the Standard Oil Company of Indiana, Chicago, were elected associate editors of the Technologie Monographs.

RECENT DEATHS

PROFESSOR EMERITUS HENRY C. COWLES, for many years a member of the department of botany of the

University of Chicago, died on September 12. He was seventy years of age.

DR. GEORGE FREDERICK ARPS, professor of psychology and dean of the School of Education of the Ohio State University, died on September 16 at the age of sixty-five years.

CHARLES LADD NORTON, director of the Division of Industrial Cooperation and Research at the Massachusetts Institute of Technology, died on September 8 in his sixty-ninth year.

DR. HALL CANTER, professor of chemistry and geology and dean of the faculty at Randolph-Macon College, Ashland, Va., died on September 2 at the age of sixty-six years.

DR. HORACE J. CHILD, instructor in zoology and physiology at Sacramento Junior College, California, died suddenly on August 31 at the age of thirty-seven years.

GEORGE W. TOWER, JR., mining engineer on the staff of Guggenheim Brothers from 1918 to 1937, died on September 13 at the age of sixty-seven years.

DR. HEINRICH KARNY, an entomologist specializing in orthoptera, formerly a member of the staff at the Botanical Garden at Buitenzorg, Java, died on August 7.

SIR SPENCER LISTER, director of the South African Institute for Medical Research at Johannesburg, died on September 6 at the age of sixty-three years.

SCIENTIFIC NOTES AND NEWS

THE National Academy of Sciences will hold its autumn meeting at Brown University, Providence, R. I., on October 23, 24 and 25. Dr. Henry Merritt Wriston, president of the university, will welcome the academy on Monday morning and there will be a response by the president of the academy, Dr. Frank B. Jewett. Scientific sessions will be held on Monday and Tuesday and on Wednesday morning. There will be luncheon daily in the Faunce House Art Gallery and dinners on the evenings of Monday and Tuesday.

DR. M. R. FENSKE, in charge of petroleum refining research and director of industrial research of the School of Chemistry and Physics at the Pennsylvania State College, has been elected a fellow of the Institute of Petroleum, London.

SIR DAVID MILNE-WATSON has been elected president of the newly established British Gas Research Board of the gas industry.

DR. FRANK N. FREEMAN, professor of educational psychology at the University of Chicago, has been appointed to succeed Dr. W. W. Kemp as dean of the School of Education of the University of California.

DR. BERYL I. BURNS, director of the department of anatomy in the School of Medicine of the Louisiana State University, has been appointed dean of the school to succeed Dr. J. Rigney D'Aunoy, who retired on August 19.

DUGALD C. JACKSON, JR., from 1935 to 1938 president of the Lewis Institute, Chicago, has been appointed dean of the College of Engineering at the University of Notre Dame. Professor Carl Wilcox, of the university, has become dean of the department of mechanical engineering, succeeding Professor William L. Benitz, who retired last spring.

DR. P. SWINGS, associate professor of astrophysics and spectroscopy at the University of Liège, has been appointed a visiting member of the faculty of the University of Chicago. He plans to spend two months at McDonald Observatory and four months at the Yerkes Observatory. He will give lectures on astrophysics.

DR. B. R. TEARE, of the School of Engineering of Yale University, will direct the program of advanced study in electrical engineering at the Carnegie Institute of Technology, which has been made possible by a Buhl Foundation grant of $50,000. The project will be supported over a five-year period by the Buhl grant. The program has been planned so that engineers, already well trained in the electrical field, will pursue industrially useful research.

DR. PARKER DOOLEY, assistant professor of pediatrics at the Cornell University Medical College and associate attending pediatrician at the New York Hospital, has been appointed assistant professor of pediatrics at the University of Chicago.

DR. ALBERT B. SABIN, associate of the Rockefeller Institute for Medical Research, New York, has been appointed assistant professor of pediatrics at the University of Cincinnati.

DR. L. R. KUHN, of Pitcairn, Pa., has been appointed assistant professor of bacteriology at the University of Georgia.

DR. KRAUCH, authority on special problems of chemical production, has been appointed to an honorary professorship in the University of Berlin. He has directed the technical development of benzine production by hydrogenizing coal.

THE following appointments at the Faculty of Medicine of Paris are recorded in the *Journal* of the American Medical Association: Dr. Aubertin, professor of

therapeutics; Dr. Henri Bénard, professor of experimental pathology; Dr. Lévi Valensi, professor of the history of medicine, and Dr. Velter, professor of ophthalmology.

DR. CORNELIUS P. RHOADS, associate member of the Rockefeller Institute for Medical Research, has been elected director of the Memorial Hospital, New York City, in succession to Dr. James Ewing, professor of oncology at the Cornell University Medical College.

BARTLETT FROST has been appointed dioramist and Virginia S. Eifert, director of publicity, at the Illinois State Museum. Mr. Frost had been previously for four years dioramist with the National Park Service Museum Laboratories, and for one year with Joe Mora, the California sculptor, in preparing dioramas for the Golden Gate Exposition at San Francisco. At the Illinois State Museum he will continue a series of cultural dioramas begun last year by H. Brainerd Wright.

W. STEPHEN THOMAS, director of education at the Academy of Sciences of Philadelphia, has been appointed executive secretary of the Committee on Education and Participation in Science of the American Philosophical Society. This committee, under the chairmanship of Professor Edwin G. Conklin, executive vice-president of the society, will make a survey of adult education in science, using the Philadelphia region as an experimental area. The Franklin Institute, the Academy of Natural Sciences of Philadelphia, the Wagner Free Institute, the Museum of the University of Pennsylvania and other organizations will cooperate. Mr. Thomas has been granted a year's leave of absence by the Academy of Natural Sciences and during that time his place will be filled by Charles E. Mohr, of Reading.

DR. CARL L. HUBBS, curator of fishes at the University of Michigan, is making an investigation for the U. S. Fisheries Service of the fisheries, fur seals and other problems in Alaska. The work of the Bureau of Biological Survey is also being studied. Dr. Hubbs sailed from Seattle on July 4. He has traveled on the *Brant*, the vessel of the service, as well as by airplane and other means.

DR. W. C. MUENSCHER, professor of botany at Cornell University, who had leave of absence during the spring term, returned to Ithaca on September 8 from a trip of seven months through the southern and western states. The departments of botany in a number of colleges and universities were visited, and material for research and teaching was collected. More than 3,000 numbers of plant collections for the herbarium of Cornell University were obtained. Dr. Muenscher was one of the survivors of the party that was struck by an avalanche on July 22, on Mount Baker, Washington, in which six of the climbers lost their lives.

DR. HAROLD H. PLOUGH, Rufus Tyler Lincoln professor of biology at Amherst College, and Dr. Philip Ives and Dr. George Child, members of his department, who were passengers on the *Athenia*, are reported to have returned to the college.

THE first series of William Alanson White Memorial Lectures on "Modern Psychiatric Conceptions" will be given by Dr. Harry Stack Sullivan, president of the William Alanson White Psychiatric Foundation and president of the Washington School of Psychiatry, on Friday evenings in the auditorium of the Department of the Interior, Washington, D. C. The titles of the lectures are: October 27, "Conceptions of Modern Psychiatry"; November 3, "Organism and Environment"; November 10, "Diagnostic and Prognostic Syndromes"; November 17, "Explanatory and Therapeutic Conceptions"; November 24, "Prospective Developments and Research."

APPLICATIONS must be on file with the United States Civil Service Commission at Washington, D. C., not later than October 12 for the position of director of the Nautical Almanac at the Naval Observatory, Washington, D. C., at a salary of $6,500 a year. The qualifications of candidates will be passed upon by a special board of examiners composed of Dr. James Robertson, retired, formerly head of the Nautical Almanac Office; Dr. Dirk Brouwer, of Yale University; Dr. H. R. Morgan, principal astronomer, Naval Observatory, and A. W. Volkmer, examiner of the U. S. Civil Service Commission. The duties of the position will be to act as scientific and administrative head of the Nautical Almanac Office and professional consultant of the Navy Department in theoretical astronomy, calendarization and allied subjects; to have independent technical and administrative charge of the important, highly difficult work of producing the annual issue of the American Ephemeris and its supplementary volumes and to be responsible to the Navy Department for their scientific accuracy; to initiate, direct and report upon basic research problems in theoretical astronomy, performing developmental work in connection therewith and to be responsible for the difficult and highly technical mathematical deductions having to do with improving the tables forming the fundamental basis underlying the production of the annual volumes; to act as a member of the Astronomical Council of the Naval Observatory, advising as to the planning and execution of its work, and to take part in astronomical conferences of a national or international character, acting as the Navy Department's representative.

IN 1940 the spring meeting of the American Chem-

ical Society, which now has 22,374 paid members, the largest number in its history, will be held in Cincinnati, Ohio; the autumn meeting in Detroit, Mich. In 1941 the spring meeting will be in St. Louis, and the autumn meeting in Atlantic City under the auspices of the Philadelphia section.

THE Bronx Health Unit, New York City, which is being erected at a cost of $400,000, was dedicated by Mayor Fiorello La Guardia on September 18. It is expected that the building will be completed by May, 1940. Health Commissioner John L. Rice presided. Invited speakers included Borough President James J. Lyons, Dr. George E. Milani, president of the Bronx County Medical Society, and Commissioner Irving V. A. Huie, of the Department of Public Works. The unit will include an auditorium, an exhibit room for health education, a staff lunchroom and kitchen and an air-conditioned storage vault in the basement. The first floor will contain the Bronx offices and child health, dental and maternal care quarters. Tuberculosis and venereal disease prevention activities will be housed on the second floor. Administrative headquarters for the health officer and his staff and health education and conference rooms will be on the third floor. The fourth floor will include borough offices for the sanitary superintendent, the Bureaus of Food and Drugs and Preventable Diseases and offices for visiting nurses and cooperating health agencies.

THE forty-fourth annual meeting of the American Academy of Ophthalmology and Otolaryngology will be held in Chicago from October 8 to 13 at the Palmer House. The academy will present courses of instruction to be given by more than a hundred specialists. There will be four afternoon programs of motion pictures and a scientific exhibit in addition to its formal scientific program. There will be one joint session at which Dr. George M. Coates, Philadelphia, will deliver his presidential address and Dr. Burt R. Shurly, Detroit, will be introduced as the guest of honor for the year and will deliver an address. At this session a symposium on essential hypertension will be presented by Drs. Albert C. Furstenberg, Ann Arbor, Mich., speaking from the standpoint of the otolaryngologist; Henry P. Wagener, Rochester, Minn., the ophthalmologist, and Roy W. Scott, Cleveland, the internist. Two foreign guests will address the section meetings, which will be held on alternate afternoons. Professor Josef Igersheimer, Istanbul, will discuss "The Optic Nerve and Diseases of Hypertension," and Arthur DeSa, Pernambuco, Brazil, will speak on "Ethmoiditis."

THE New York State Geographical Association will meet on September 23 at Syracuse University. In the morning there will be a series of papers on the teaching of geography. In the afternoon, Dr. Roy Price will lead a round table discussion on "The Relation of Geography to the Regents Investigation," and a similar discussion will be conducted by Dr. George B. Cressey on "The Place of Geography in the Secondary and High School." Dr. C. Grove Haines, of the department of history of Syracuse University, will speak at the banquet on "The Relationship of Geography and History in the Present European Crisis."

DISCUSSION

NUTRITIONAL PHYSIOLOGY OF THE ADULT RUMINANT[1]

IN this monograph Ritzman and Benedict set forth results of their own researches and also undertake to present a review "chiefly of the American literature" dealing with "the researches of the last few decades."

The authors' investigations are set forth *in extenso,* but the recognition of the work of others is highly inadequate.

The digestibility of the ash of feeding stuffs, as indicated by comparison of the constituents of feed and feces, is discussed (p. 13) as though significant, whereas it is thoroughly understood that the quantities of mineral substances in the feces signify nothing definite in relation to the digestibility of these components of the food.

[1] Comments on the monograph on this subject by E. G. Ritzman and F. G. Benedict, Carnegie Institution of Washington Publication No. 494.

The authors write uncritically as to certain practical matters; thus (p. 21) their statement that "at the larger stock yards of the country—fat steers are always bought subject to a 3 per cent. shrinkage in weight" is not true. Upon arrival at the central live-stock markets cattle are first given an opportunity to eat and drink. After they have been sold the packer-buyer pays for them at their actual weight, as they go over the scales, after eating and drinking.

In regard to methane production Ritzman and Benedict say (p. 26), "On the basis of seven "discordant results" in their calorimeter experiments Armsby and Fries concluded that 4 grams of methane result from every 100 grams of carbohydrate ingested, and this factor was later used largely by Forbes and by Mitchell to estimate the losses of energy by this path."

As a matter of fact the methane production has been experimentally determined in every calorimetric experiment conducted with cattle at this institute, and

The writer has never used the above-mentioned factor for any purpose.

The authors present a graph (p. 75) in which the heat production is plotted against the insensible perspiration; and this graph is interpreted (p. 77) as showing that the insensible loss may be used as a basis of computation of the heat production; but the experiments involved were all conducted at about the same plane of nutrition. The results, therefore, do not establish a relationship of general significance. The authors should certainly have given careful consideration to Kriss's extensive studies of the relationship of the insensible loss to the heat production in cattle.

In regard to the "profound," "seriously challenging," "extraordinary" and "astounding" variability of the basal metabolism as observed with cows (p. 86)—the causes of the variability observed were not determined. Observations on the proximity of the period of oestrum to the time of determination of the basal metabolism would have been pertinent, as also a discussion of the normal body temperature of cattle, which is much more labile than is that of human beings.

One would prefer to maintain an open mind on this subject of lability of the basal metabolism of cows until the reasons therefor have been clarified, but we are told (p. 129) that "the overwhelming evidence presented here makes it obligatory on the part of every research worker to accept the demonstrated fact that the large domestic ruminant (particularly the genetically highly specialized dairy cow) has a very labile basal metabolism."

An attempt is made to support these findings in regard to cows by reference to determinations of so-called "standard metabolism" in steers (p. 130) by measurement of the heat production "in two or three successive half-hour periods while the animal was standing quietly, 24 hours after food."

According to the writer's understanding, measurements of the heat production of steers under the conditions stated would possess no standard significance, because of the brevity of the periods of observation and because the alimentary fill would be in no definite status.

Ritzman and Benedict imply (p. 178) that their observations on the lability of the basal metabolism of cows invalidates the four remarkably smooth and consistent curves of heat production in relation to the plane of nutrition, as determined, with steers as subjects, by Forbes and associates.[2] In our opinion the smoothness of these curves shows that the lability of the basal metabolism of cows, as observed by Ritzman and Benedict, is not characteristic of the metabolism of steers under successful experimental control.

[2] *Jour. Agr. Research,* 37: 253–300, 1928; 40: 37–78, 1930.

In discussing the energy expense of food utilization Ritzman and Benedict (p. 149) deplore the fact "that such a confusion of expressions to describe one and the same effect (the heat increment) exists," and then propose two more expressions for the same purpose. In this relation they state that "the Pennsylvania investigators" compute the heat increment to the basis of standing half the time and lying half the time. As a matter of fact the *heat production* has properly been so treated, but the heat increment, never.

Ritzman and Benedict conclude (p. 99) that the increase in heat production during standing exceeds that during lying to a greater extent during feeding than during fast, but the values they determined for percentage increase due to standing during fast all lie within the range of variation of such determinations during feeding, and there seems to be no statistical basis for the conclusion drawn.

As to the method of estimating the heat increment the authors say (p. 149): "Unfortunately the stimulating effect of food can at present only be determined by measuring the metabolism under this influence of food and without it, so that fasting becomes a necessary part of the technique of its determination."

The authors thus seem to ignore the fact (of which they are doubtless aware) that Kellner, Armsby and Forbes and associates have all measured heat increments for production by the differential method, above maintenance, without reference to fast; and they also ignore the conclusion of Forbes and associates (emphasized in several papers) that heat increments depending on measurements of heat production at planes of nutrition below the point of energy equilibrium are lower than the truth by the amount that the food diminishes the production of heat at the expense of body nutrients.

In the light of this conclusion Ritzman and Benedict's determination (pp. 169–176) of the dynamic effects of feeds with the basal metabolism as the base value is lacking in definite significance.

Ritzman and Benedict's idea (p. 186) that the high basal metabolism of lactating cows "suggests definitely that the stimulating effect of food is as much an essential to lactation as is the energy and other substance matter from which the milk is formed" seems to us to misinterpret a residual effect—a carrying over into the measurement of the basal metabolism—of the habit of high heat production resulting from the high food consumption of lactation.

Finally, the authors' assumption (pp. 187–8) "that the deposit value of metabolizable energy in amounts above maintenance is the same as for maintenance," based upon an opinion published by Armsby in 1919,[3] ignores extensive work on this subject which was

[3] *Jour. Agr. Sci.,* 9: 186, 1919.

planned and in the main conducted by Armsby, and, after Armsby's death, was completed by the writer and his associates, and published in 1926.[4]

In this work the energy outgo during fast was used as the base value of heat increments of food for maintenance, and the heat production of maintenance was used as the base value of heat increments of food for body increase and milk production. On this basis the relative efficiency of utilization of metabolizable energy for maintenance, milk production and body increase was found to be, on an average, as 79.1, 72.8 and 57.3 per cent., respectively.

During recent years, however, the writer and his associates have advocated another point of view in this relation, involving the conception of a new base value of heat production—that of fast minus the energy expense of utilization of the body nutrients katabolized during fast. The present indication, from investigations not yet completed, is that from this more fundamental point of view the utilization of metabolizable energy for maintenance and for moderate amounts of body increase may be indeed essentially the same.

E. B. FORBES

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HEPARIN AND BLOOD CLOTTING

IN a recent note[1] on this topic Astrup emphasizes the need for a plasma (or serum) factor necessary to the inhibitory action of heparin. It should be recognized that this was clearly enunciated by Howell and Holt[2] in the original work on heparin and, under the name of the *pro-antithrombic* (or *antithrombin-ogenic*) factor, has always held a prominent place in Howell's theory of blood coagulation. Quick[3] afforded evidence that the accessory factor was associated with the albumin rather than with the globulin fraction of the plasma proteins. Some recent investigations[4] confirm this point but stress a new interpretation which appears to clarify the "controversial statements" in the literature. It has been found that heparin readily *prevents* thrombin formation (the *antiprothrombic* action of Howell and Holt), provided that pure cephalin is used as the thromboplastic agent in forming thrombin from recalcified prothrombin. However, if tissue extracts (thrombokinase) or crystalline trypsin (thromboplastic enzyme[5]) are used instead of cephalin, the antiprothrombic action of heparin is overcome in all but the first minute or two of the process of thrombin formation.

The synergistic *antithrombic* (thrombin-*neutralizing*) effect of heparin-albumin mixtures is not dependent upon the mode of thrombin formation, in experiments which avoid thrombinolysis. Additional work is necessary to elucidate the true nature of "antithrombic" action, but there are clear indications that it shares with the process of thrombin formation a significant dependence upon the phospholipid-protein interrelationships in which a trypsin-like enzyme plays a leading rôle.

JOHN H. FERGUSON

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THE BLACK DYE OF THE NAVAJOS

CARNOTITE, a canary yellow mineral usually found as a powder in the sandstones and conglomerates of the Colorado Plateau, has been and still is used by the Navajo Indians to make a black dye to color the wool which they shear from their sheep to make the famous Navajo rugs.

Carnotite is known to-day to be an ore of radium, uranium and vanadium. It was not until 1898 that the chemical composition was determined by Fuedel and Cummenge, of Paris, from samples obtained from the Colorado Plateau by Kimball and Poulot. Long before that, the Navajo Indians had learned the art of preparing a rich black dye from the yellow mineral —"a uranium black." The yellow powder had formerly been reported as "yellow ochre," a form of limonite.

The writer is indebted to Mrs. Louisa Wade Wetherill, of Kayenta, Arizona, for the method used by the Navajo Indians in preparing the dye. The carnotite powder is roasted in a frying pan placed over an open fire until it changes in color from yellow to black. In a similar manner, the Navajos roast the pitch from the pinyon trees (stunted pines) that grow on the high mesas in the region. The pitch becomes brittle and breaks down to a black powder. These two black powders are then mixed and stirred into a solution prepared by boiling the entire plant of the squaw-berry bush (*Rhus trilobica*) in water until it assumes the color of tea. This makes a concentrated dye which is further diluted with water to the required strength.

In a rug which the writer obtained from the Western Navajo Indian Reservation, the uranium black dyed wool was used in combination with wools colored with natural vegetable dyes prepared from the root of the caniegra plant (wild pie plant or dock). Various colors may be obtained by varying the length of time the roots of the plant are boiled in water. The colors range from *old gold* through *greenish yellow* to a brown approximating the color of *burnt sienna*. The longer the period of boiling, the more brownish is the color obtained.

DANIEL T. O'CONNELL

THE COLLEGE OF THE CITY OF NEW YORK

[4] *Jour. Agr. Research*, 33: 483–492, 1926.

[1] T. Astrup, SCIENCE, 90: 36, 1939.

[2] W. H. Howell and E. Holt, *Am. Jour. Physiol.*, 47: 328, 1918.

[3] A. J. Quick, *Am. Jour. Physiol.*, 115: 317, 1936.

[4] J. H. Ferguson, *Proc. Soc. Exp. Biol. and Med.* (in press).

[5] J. H. Ferguson and B. N. Erickson, *Am. Jour. Physiol.*, 126: 661, 1939.

APPEARANCE OF A NEW POTATO DISEASE IN NORTHEASTERN COLORADO

A NEW disease, apparently caused by the feeding of the pentatomid (*Chorochroa sayi* Stål), has appeared in the potato fields of northeastern Colorado.

On July 20 calls from farmers in Morgan County, Colorado, brought attention to what seems to be a general condition in the medium-early and late plantings of potatoes. The pentatomids were found associated with the disease in every case of the several hundred plants examined.

Cage experiments at the Greeley Potato Experiment Station begun on July 31 with plants known to be free of psyllids and disease, have demonstrated that the Say's pentatomid, feeding on the plants, is definitely responsible for the condition.

Medium-early plantings show 15 to 20 per cent. of diseased plants, while many late plantings in the Greeley area show 50 to 60 per cent. of pentatomid-affected plants.

The feeding may cause a complete wilting of the leaves or tips of the plants. Where the feeding is confined to the stems of the lower part of the plants, the symptoms become more general. Associated with the feeding is a basal curling of the terminal leaves, a yellowing followed by a reddish discoloration along the margin and an erect condition of the affected foliage. The tubers may be produced in chains or, in the more mature tubers, serious bumpiness and malformation may occur. The number of insects on each plant determines the severity of the disease. In the Morgan County area, an average of eleven adult insects was found on each plant. Plants attacked by three or four insects were only mildly affected, while those on which there were nineteen or twenty adult insects showed extreme symptoms.

The disease is very similar to "psyllid yellows," caused by the tomato psyllid, *Paratrioza cockerelli* (Sulc.).

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REPORTS

THE VULCANIZATION OF RUBBER

THE centenary of the discovery of the vulcanization of rubber by Charles Goodyear was celebrated on Wednesday, September 13, at the ninety-eighth annual meeting of the American Chemical Society. Numerous papers describing the progress of rubber research and manufacture in the United States were read at a general meeting in the afternoon.

At the banquet in the evening, Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, spoke on "Looking Forward in Research"; Dr. James Bryant Conant, president of Harvard University, discussed "Lessons from the Past," and P. W. Litchfield, president of the Goodyear Tire and Rubber Company, Akron, Ohio, described "Rubber's Position in Modern Civilization."

In his address Dr. Compton said:

> A good deal has been said about the ways in which science has been applied to make warfare more destructive, just as science has also been applied to bring about a certain compensating degree of protection against new weapons. But there is one possibility in science which seems to me to be far more significant than these, namely, the use of science to remove some of the major causes of war.
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> In so far as wars are caused by the natural "cussedness" of human nature, science can contribute if at all only very indirectly. It can probably not do much toward removing the desire which some men have for great domination. It can not remove ambition and envy from the human breast. But in so far as wars may be induced by economic considerations, science may do much to remove the causes.
>
> One of the earliest incentives to war was the invasion of one country by another for the purpose of loot. Later, as we became more civilized, this took the form not so much of loot as of the control of population for the purposes of taxation and of exploitaton of labor and of natural resources. This is all part of the old primitive instinct of animals and men to secure the good things of life by taking them from someone else.
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> Science, however, has given mankind a method of gaining the good things of life without taking them from someone else and without working inordinately long and hard to produce them. Discovery and development of "good things of life" by science, engineering and invention are a far more certain and productive source than organized loot and robbery. To the extent therefore that great groups of people, such as nations, can be induced to support technological development directed toward these ends, to that extent can they satisfy their desires, without recourse to war.
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> More specifically, many nations have felt the urge to conquest in order to secure to themselves an assured supply of various materials which are necessary to the nation's economy. For example, Great Britain needs oil for her navy and food for her population, which can not be produced in the British Isles. Germany and Japan need rubber, food stuffs and mineral resources. Even the United States, richest of all nations in its mineral resources, is inadequately supplied with such important materials as rubber, tin and tungsten. Does national safety force these nations to conquest in order to assure themselves of these commodities?
>
> The necessities of national economies could be taken care of by scientific research at a cost far less than that of a major war and within a time far less than that in which the effects of a major war could be recovered from. At

the same time this could be done not only without hurting any one but with great indirect benefit to all concerned. Let me give a few examples.

The time will surely come in the not too distant future when a satisfactory motor fuel can be produced from coal at a cost which is not too far out of line with that of petroleum products. When this happens, Great Britain, for example, will no longer be critically dependent upon the Persian oil fields nor will we be so much worried about Japan's efforts to secure a foothold in Mexico.

When substitutes for rubber are produced which are satisfactory for automobile tires and which can be produced at a reasonably competitive price, then one of the great causes of anxiety and international haggling will have been removed. Perhaps the new development of "chemical agriculture" in which farm products are produced without soil by planting them so their roots are bathed in appropriately nutritive chemical solutions can be developed to remove the fear of food shortage which now causes so much anxiety in several nations, and will at the same time provide a diet which will be a distinct improvement on that which is now customary.

The development of suitable lacquers as substitutes for tin in the coating of containers for canned foods will make the United States less anxious about its access to the Bolivian tin supply. Or perhaps improved methods of extraction from our existing but rather poor tin deposits may accomplish the same result. To the extent that science can produce these materials or suitable substitutes, to that extent will be removed almost the only basis for war which can be intelligently argued for at the present time.

Dr. James B. Conant, president of Harvard University, holder of the William H. Nichols Medal of the New York Section of the American Chemical Society, said in an address on "Lessons from the Past":

One might claim that our scientific knowledge of large molecules and the chemical reactions which produce them is but a by-product of the ubiquitous motor car. Fifty years ago a celebration of Goodyear's discovery would have awakened almost no interest among chemists, for the science of rubber chemistry was hardly born. It would have awakened almost no interest among the general public, for the automobile was still unknown.

The total world's annual production of rubber was then less than 50,000 tons. It was not till the first years of this century that the production began to rise and not till the second decade that a phenomenal upswing commenced.

And why did the annual production reach 200,000 tons by 1916 and 500,000 tons by 1924? The answer is obvious. Tires for automobiles. From 1910 to 1930 the curves of rubber production and automobile registration rise together; during the last decade they rise and fall, somewhat, in almost parallel fashion. I venture to predict that if some industrious soul should count the number of articles published in scientific journals dealing with the chemistry of rubber and rubber-like compounds, he would find that the annual production from the laboratories followed the growth curve of the automobile industry.

One can have no adequate picture of scientific progress, I believe, without examining the social and economic conditions under which this progress took place. Admittedly, one can carry the economic interpretation of history, including the history of science, to absurd lengths. But one can also fail to understand the lessons of the past by reading the history of science solely as the story of scientific heroes who lived and moved in a vacuum.

Viewed in historical perspective, the contempt of the practical man for all scientific work, unless it has immediate utility, is seen to be shortsighted. Patience is needed by the scientist. It is no less needed by society in evaluating the work of our universities and research laboratories.

On the other hand, the scorn of some cloistered scientists and scholars for the inventor and the industrial worker is clearly equally shortsighted.

In science, as in other human activities, looking down one's nose at other people is worse than a ridiculous pastime. It is often equivalent intellectually to throwing a monkey wrench into the machinery. If my thesis is correct, that in the long run pure science and applied science are so closely interrelated as to be inseparable, then clearly when one lacks nourishment the other must eventually wither and inevitably die.

So industrialists and scientists may well join together in celebrating either a great discovery in pure science or a revolution in the industrial arts. For on close analysis both events are seen to be of equal significance for the attainment of these goals for which the two groups strive. And they may ask the other members of the community to join with them when they pay honor, as to-night, to a pioneer who opened doors to riches for mankind he little dreamed of. Treasures not measured in material terms alone, new weapons in man's intellectual armory—perhaps the only enduring wealth of modern times.

P. W. Litchfield, president of the Goodyear Tire and Rubber Company, Akron, Ohio, in an address on "Rubber's Position in Modern Civilization," said:

In fixing rubber's position in modern civilization it is possible to say that four million persons, the world over, are employed in the rubber business; it may also be pointed out that almost three billions of dollars are invested in facilities for the growing, manufacture and distribution of rubber; we may consider the fact that there are more than fifty thousand different and useful products made from rubber and that more than two billion pounds of pure rubber are consumed in a normal year.

But such measurements are inadequate. The influence and importance of rubber is so all-pervasive as to defy any rule of thumb. I believe we get closer to the real answer when we think of our social and economic structure as a living thing, the skeleton of which is composed of metal and stone, the arterial system of which carries a life stream of oil and the flexing muscles and sinews of which are of rubber.

I could go on indefinitely—into the building industry, into the modern conveniences of our homes and offices, into food packaging, into the operating rooms of the hospitals, into the mines and factories—and show to you the threads of vulcanized rubber which are woven back and forth through the fabric of modern living.

SPECIAL ARTICLES

ANDROGENS AND TUMOR GROWTH

THE observation of Murray[1] that male mice bearing ovarian grafts developed spontaneous mammary tumors, although normal males do not, and the observation of Lacassagne[2] that the same effect could be reproduced in males by means of injected estrogens suggested a possible antagonism between male and female sex hormones as regards their carcinogenic properties.[3] Accordingly, in the fall of 1935 experiments were begun on the effects of urinary androgens on the growth and metastasis of the Brown-Pearce epithelioma of the rabbit. Preliminary observations having proved encouraging the experiments have continued to the present, employing over 300 rabbits. In one paper[4] now in press the results with several chemically pure androgens, one estrogen and androgens extracted from human urine are presented in detail. In another[5] some further evidence is presented of the opposite effects on growth of the most active androgen and the most active estrogen available.

Urinary-extract androgens and chemically pure testosterone propionate, both in small doses, quite definitely inhibited the growth of the primary Brown-Pearce tumor implanted in the testicle. For a study of secondary growths (metastasis) four degrees of malignancy were recognized: (1) no secondary growths; (2) few, *i.e.*, less than four scattered small nodules; (3) several, *i.e.*, 3 to 6 sites with multiple nodules; and (4) extensive, *i.e.*, diffuse involvement of 6 or more sites. A summary of the longer-period experiments, running from 89 to 112 days, is given in Table 1. The androgens were injected daily in olive or sesame oil. Controls with and without oil alone showed no material difference in the spread of secondary growths. The average of these two control groups is taken as the unmolested incidence of such growths when the tumor is of average malignancy. Estradiol monobenzoate did not change the percentage of animals having any degree of metastasis or none. The urinary androgens, however, did very positively shift the incidence from the high side of the scale toward the low side. Still greater was the effect of testosterone propionate (10 to 50 I.U. daily) in the same direction. Instead of twenty-nine per cent. (average of the two control groups) having extensive metastases there were none in the group receiving this most potent androgen.

TABLE 1

LONG PERIOD EXPERIMENTS

	No. of rabbits	Degree of Metastases: Extensive No.	Extensive Per cent.	Several No.	Several Per cent.	Few No.	Few Per cent.	None No.	None Per cent.
Control no oil.	25	8	32	7	28	2	8	8	32
Control oil only	35	9	25.8	8	22.8	7	20	11	31.4
Estradiol Monobenzoate	18	5	27.8	5	27.8	3	16.6	5	27.8
Urinary androgens 4.6 to 216 I.U.	55	4	7.3 (−21)	14	25.4 (−1)	13	23.6 (+10)	24	43.6 (+12)
Testosterone 37 & 39 I.U. .	22	9	40.9 (+12)	7	31.8 (+5)	2	9.1 (−5)	4	18.2 (−14)
Testosterone Propionate 10 & 50 I.U...	20	0	0.0	2	10.0	7	35.0	11	55
Total	175	(2–29)		(−16)		(+21)		(+23)	

The figures in parentheses represent the changes in percentage from an average of the two control groups. The shift to the low side of the scale of metastases caused by urinary androgens and by testosterone propionate is impressive. The opposite effect of testosterone is not so great.

Conversely, instead of 32 per cent. having no metastases as in the controls there were 55 per cent. having none. Curiously enough, chemically pure testosterone had a moderate effect in the opposite direction.

In experiments which ran to only 60–62 days pure androsterone and dehydroandrosterone, in doses comparable to those used for most of the urinary androgen injections, had no material effect on either the rate of primary growth or the incidence of secondary growths. It is therefore probable that the urinary extracts contain one or more steroids, extractable by the same method as the known androgens, which are responsible for the inhibiting effects noted. Fractionation of such extracts has already been accomplished, and the chemically different groups will be tried soon for anti-carcinogenic properties.

In the short-period experiments also testosterone propionate in doses of 100 and 250 I.U. daily seemed to exacerbate the metastatic process. Dosage therefore is of great importance.

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EASE OF BODY HEAT LOSS AND RESISTANCE TO INFECTION

WE wish here briefly to report a rather striking dominance exercised over resistance to infection by the ease with which body heat can be lost. White mice

[1] W. S. Murray, *Jour. Cancer Res.*, 12: 18, 1928.
[2] A. Lacassagne, *Compt. Rend. Acad. Sci.*, 195: 630, 1932.
[3] I. T. Nathanson and H. B. Andervont, *Proc. Soc. Exp. Biol. and Med.*, 40: 421, 1939.
[4] J. R. Murlin, C. D. Kochakian, C. L. Spurr and R. A. Harvey, *Arch. Path.*, in press.
[5] C. D. Kochakian, *Endocrinology*, in press.

adapted to moist heat (90° F. and 65 per cent. relative humidity) exhibit a resistance to infection only one quarter as great as do litter mates adapted to a cool environment (65° F.), while mice in a control room at 70–75° F. fall midway between those in the hot and cold environment. This occurs when all other factors of life are held as constant as possible for all groups—same diet (Purina dog chow), similar lighting and ventilation, and the use of divided litters for the different groups to minimize the hereditary factor.

We have previously described the rooms and equipment used in this study[1] as well as the dominance exercised by ease of body heat loss over such basic physiologic functions as rate of growth and development, fertility and longevity. This dominance in man and animals seems to work through the internal combustion level allowed the individual. Energy for most physiologic functions can come only from this combustion, but body efficiency is not high, so that a large part of the combustion energy must be dissipated as waste heat. It is the ease or difficulty with which this waste heat can be dissipated that causes internal combustion rate to be dominated by external temperature levels. Men, as well as animals, show direct evidence of this dominance.[2]

Locke[3] has described a "fitness index" which he bases largely on the rate of oxygen consumption, resistance to infection being proportional to the rate of oxygen uptake. And in certain of man's infectious diseases, ability to survive seems definitely related to prevailing mean temperature level.[4] It therefore seemed important that a close analysis be made of all phases of this dependence on ease of body heat loss, the preliminary findings on resistance to infection being set forth in this brief note.

Using a 10-hour broth culture of hemolytic streptococcus kept at standardized virulence by the necessary mouse passages (so that 0.5 cc intraperitoneally kills healthy control mice within 16 hours), the estimates of M.L.D. given in Table 1 were obtained.

Although the M.L.D. was the same for control and cold-room animals, those from the control room died more quickly than did those from the cold. During the period of these tests, the control room temperature was about 70° F., only 5° above that of the cold room. Hot room mice succumbed with only one fourth the culture dosage needed to kill those of the other two groups.

When mice of all three groups were injected with the same amount of broth culture, 0.5 cc of a 1:20 dilution, then within 26 hours 100 per cent. of the hot room mice were dead, 60 per cent. of those from the control room, but only 30 per cent. of those from the cold. In another series injected with 0.5 cc of a 1:55 dilution of broth culture, 60 per cent. from the hot room were dead within 30 hours, but only 12 per cent. from the cold.

TABLE 1

	Survival time in hours
Cold room mice (kept at 65° F) 0.5 cc of culture diluted 1–10	12, 23, 23, 23, 30, 48, 48, 48 (2 did not die)
Control room mice (kept at 70° F) 0.5 cc of culture diluted 1–10	7½, 11, 12, 12, 12, 23, 23, 23, 23, 132 (1 did not die)
Hot room mice (kept at 90° F) 0.5 cc of culture diluted 1–40	24,24, 30, 36, 50, 108 (1 did not die)

There can be left little doubt, therefore, that difficulty in body heat loss and a lowered tissue combustion rate result in a sharply reduced ability to fight infectious invasion. This depressive effect on resistance to infection (also on growth, developmental rate and fertility) is evident within two weeks after the animals have been placed in the warm environment, and is almost complete by the end of three weeks.

The study is being broadened to include other pathogenic organisms and the appearance of various immune bodies in the blood. Undernutrition from dietary inadequacy, either qualitative or quantitative, has been known to make animals less resistant to infection.[5] It is likely that difficulty in body heat loss works in a similar fashion by making impossible the adequate utilization of even the most perfect diet when offered *ad lib.*

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THE MUSCLE HEMOGLOBIN OF SEALS AS AN OXYGEN STORE IN DIVING

IT is well known that the harbor seal, *Phoca vitulina*, can remain submerged for long periods without breathing. Dives of six minutes are common, while a maximum of 15 minutes has been recorded by Millais.[1] The seal's ability to hold its breath when submerged contrasts so strongly with the slight capabilities of terrestrial mammals that one is led to suspect an extra store of oxygen in the seal's case. The

[1] C. A. Mills and Cordelia Ogle, *Am. Jour. Physiol.*, 125: 36–40, 1939.
[2] C. A. Mills, *Am. Jour. Hygiene*, 29: 147–164, 1939.
[3] Arthur Locke, *Jour. Immunology*, 36: 365–380, 1939.
[4] C. A. Mills, "Medical Climatology," Chapter VII, Charles C Thomas, Springfield, Illinois, 1939.
[5] C. F. Church, *Am. Jour. Pub. Health*, 29: 215, 1939.
[1] J. G. Millais, "The Mammals of Great Britain and Ireland," 3 vols. London, 1906.

extremely dark color of seal meat suggests that the oxygen store exists, at least in part, in the muscle hemoglobin.

The literature on muscle hemoglobin in aquatic mammals is both meager and contradictory. In a review paper on "Respiration in Diving Mammals" Irving[2] estimates the muscle hemoglobin of an aquatic mammal by analogy from Whipple's figures[3] for iron content of dog muscle, and shows that a 70 kg animal could absorb 335 cc of oxygen by this means. He concludes that such a store would, however, be only significant as a store for a fraction of a minute, whereas the endurance of divers requires provision for a number of minutes. But Theorell,[4] who observed that myoglobin occurs in concentrations of 5 to 10 per cent. in the juice pressed from seal meat, states that the necessary oxygen for prolonged diving comes with great likelihood in large part from the exceptionally great myoglobin content of the skeletal muscles, which are so strongly colored that they appear almost blue-black.

I have made some analyses to determine if muscle hemoglobin in the seal is present in concentrations high enough to serve as an oxygen store in diving. The work began with iron analyses of the tissues, as it was thought that the iron content would serve as a rough indication of the relative muscle hemoglobin concentrations. The method of iron determination followed that of Elvehjem and Hart.[5] All tissues analyzed were freed as far as possible from blood hemoglobin by washing in 0.9 per cent. NaCl solution. A single sample of seal meat gave an average of .229 mg Fe per gram of fresh tissue, compared with several analyses of beef muscle by the same method, giving an average of .048 mg Fe per gram of fresh tissue. This experiment indicated that a much larger amount of iron was present in the seal muscle.

In order to determine if the large excess of iron were really present as muscle hemoglobin, samples of tissue from a second seal were washed in 0.9 per cent. NaCl to remove blood hemoglobin, and the muscle hemoglobin was extracted by the dilute NH_4 method of Whipple.[6] The muscle hemoglobin in solution was converted to acid hematin and compared colorimetrically with a blood acid hematin standard. By this method a single sample of seal muscle yielded 7,715 mg of muscle hemoglobin per 100 grams of fresh tissue, compared with an average of 1,084 mg per 100 grams for several samples of beef muscle. In a 70 kg seal, if only 35 per cent. of the body weight represented muscle, there would be 1,890 grams of hemoglobin present, sufficient to combine with 2,530 cc of oxygen. As shown by Table 1, this might amount to 47 per cent. of the total oxygen stores of the animal.

TABLE 1

POSSIBLE OXYGEN STORES OF A 70-KG SEAL

System	Oxygen stored
Lungs	545 cc
Blood	2,055 "
Fluids	245 "
Muscle hemoglobin	2,530 "
Total	5,375 "

SOURCES OF FIGURES IN TABLE 1

Lungs: Average lung capacity of two seals examined after death was 38.9 cc per kg. $38.9 \times 70 \times \frac{1}{2} = 545$.

Blood: Oxygen capacity of seal blood is 29.3 vol. per cent. (Irving, Solandt, Solandt and Fisher[7]). Blood represents 10 per cent. of the seal's body weight (Irving).[8] $70 \times 10 \times 29.3 = 2{,}051$.

Fluids: From Irving.[9]

Muscle hemoglobin: 7,715 mg Hb per 100 gm muscle. If 35 per cent. of the seal's weight is muscle, there are 24.5 kg of muscle. $24.5 \times 10 \times 7{,}715$ mg (7.715 grams) = 1,890 grams Hb. Muscle hemoglobin has the same combining power for oxygen as does blood Hb—1.34 cc per gram hemoglobin. $1{,}890 \times 1.34 = 2{,}532$ cc.

The resting metabolic requirement of a 70 kg seal would be 373 cc of oxygen per minute according to Irving, Solandt, Solandt and Fisher.[10] Assuming 100 per cent. utilization of all oxygen stores, it would be possible for the seal metabolizing oxygen at the basal rate to remain submerged for 14.4 minutes on a store of 5,375 cc of oxygen. This figure compares favorably with the common submersion time, when the animal is active, of about six minutes. But for active 15-minute submersions, such as recorded by Millais, there still seems to be no physiological explanation.

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THE ABSORPTION OF RADIO WAVES IN WATER

IN view of the recent submarine disasters, the question naturally arises as to the possibility of signaling from undersea craft by radio. Some years ago, Mr. Allen Bassett and the author carried out a series of tests in Lake Michigan which have a direct bearing on this problem. We chose for our task the determination of the law of absorption of radio waves in water.

A small transmitter with a loop aerial and an output of about one-tenth watt was set into operation, sealed into a water-tight box and lowered with a rope

[2] L. Irving, *Physiol. Reviews*, 19: 112, 1939.
[3] G. H. Whipple, *Am. Jour. Physiol.*, 76: 693, 1926.
[4] A. T. H. Theorell, *Biochem. Zeitschr.*, 268: 81, 1934.
[5] C. A. Elvehjem and E. B. Hart, *Jour. Biol. Chem.*, 67: 43, 1926.
[6] G. H. Whipple, *Am. Jour. Physiol.*, 76: 693, 1926.
[7] *Ibid.*, 6: 393, 1935*a*.
[8] L. Irving, *Physiol. Reviews*, 19: 112, 1939.
[9] L. Irving, *Physiol. Reviews*, 19: 112, 1939.
[10] L. Irving, O. M. Solandt, D. Y. Solandt and K. C. Fisher, *Jour. Cell. and Comp. Physiol.*, 6: 393, 1935*a* and 7: 137, 1935*b*.

over the side of a boat to various depths. In the boat there was a loop aerial connected to a receiving set which was tuned to the transmitter and which operated a Wynn-Williams balanced vacuum tube voltmeter, rather than the usual loud speaker. The voltmeter gave a measure of the strength or intensity (I) of the radio wave. As the transmitter was lowered farther and farther into the water, thus increasing the thickness of the layer of water between the transmitter and receiver, the strength of the received signal decreased in the manner shown in Fig. 1. The different curves

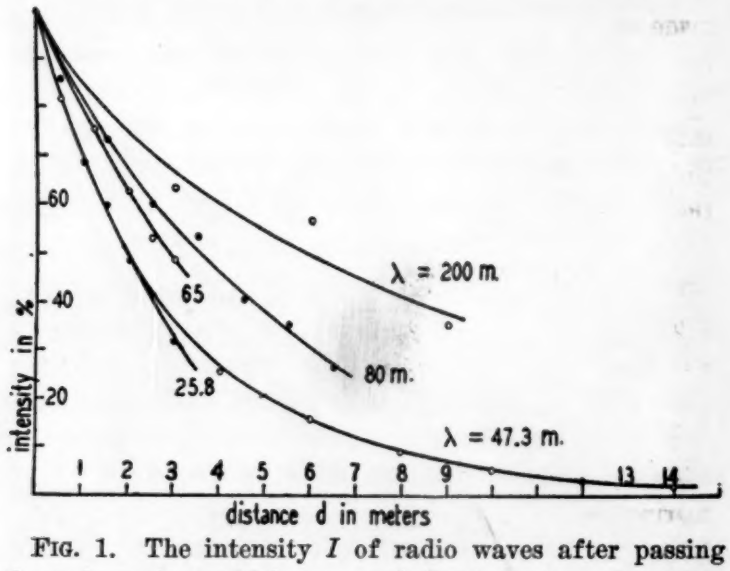

FIG. 1. The intensity I of radio waves after passing through various thicknesses of fresh water. λ = wave-length in meters.

refer to the indicated wave-lengths (λ) of the radio waves, as marked, and show that the shorter waves are more readily absorbed. Because of the rocking of the boat and the directional properties of the two loop aerials, the intensity of the received signal fluctuated considerably at any one separation of the transmitter and receiver. The intensity readings given in the figure are the maximum values at each point.

The form of the curves shown in Fig. 1 is typical of absorption processes in general and may be expressed by the well-known exponential law

$$I = I_0\, e^{-\alpha d}, \tag{1}$$

where I is the intensity of the wave after penetrating d centimeters of the absorbing material, I_0 is the original intensity at the transmitter, $e = 2.718$—, the base of the Naperian system of logarithms, and α is the so-called linear absorption coefficient. Large values of α indicate large absorption in unit thickness of the absorber and *vice versa*. If we take logarithms of both sides of equation 1 we have

$$\log_e I = \log_e I_0 - \alpha d, \tag{2}$$

or, changing to common logarithms,

$$\log_{10} I = \log_{10} I_0 + (-0.4343\alpha)d. \tag{3}$$

If, then, we plot log I against d we should get a straight line whose slope is negative and is numerically equal to $0.4343\,\alpha$. The straight lines in Fig. 2, obtained in

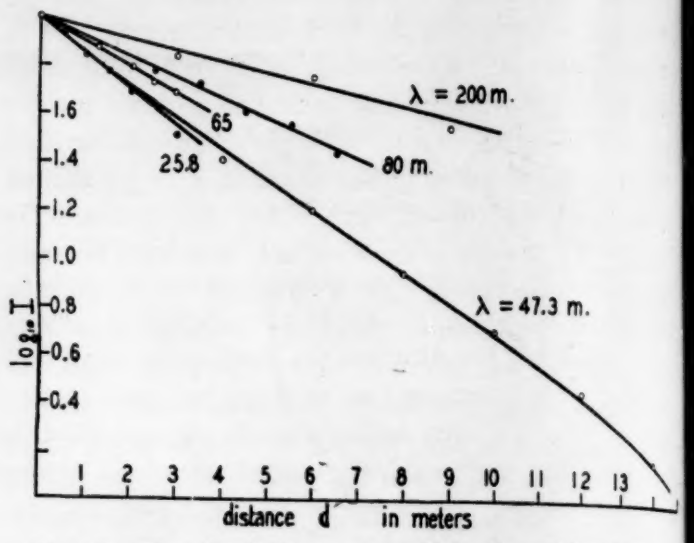

FIG. 2. Proof of the exponential absorption law and determination of the absorption coefficient α.

this manner, prove that the radio waves are absorbed in the exponential manner of equation 1 in water. The values of α computed from the slopes of the straight lines are given in Table 1.

TABLE 1

Wave-length in meters	Experimental α	Theoretical α
200	0.00117	0.00126
80	.00200	.00198
65	.00240	.00220
47.3	.00290	.00260
25.8	.00364	.00350

By means of the electromagnetic theory it can be shown in a comparatively simple manner[1] that the absorption coefficient α is related to the permeability μ and conductivity σ (e.m.u.) of the absorbing substance and to the frequency (f) of the radio wave in the following manner:

$$\alpha = 2\pi\sqrt{\mu\sigma f}. \tag{4}$$

The value of μ for water is unity. Our measured value of σ for Lake Michigan water is 2.7×10^{-14} e.m.u. Thus it is possible to calculate a value of α for each of the frequencies used in the experimental work. These theoretical values are given in the same table with those obtained from the slopes of the straight lines and show reasonably good agreement between theory and experiment. We are thus able to state with confidence that, over the range of wave-lengths tested (200 to 25.8 meters), the absorption per unit distance through fresh water increases as the square root of the conductivity

[1] A. Hund, "Phenomena in High Frequency Systems," p. 333. McGraw-Hill Book Company, 1936. G. P. Harnwell, "Principles of Electricity and Electromagnetism," p. 544. McGraw-Hill Book Company, 1938.

of the water and as the square root of the frequency of the radio wave.

We may now apply equation 1, with the known values of α, to bring into evidence the shortness of the range of transmission of radio waves through water. For example, the intensities of radio waves of wave-lengths 200, 80, 65 and 25 meters will be reduced to 10 per cent. of their value at the transmitter after passing through approximately 20, 11, 10 and 6 meters of Lake Michigan water, respectively. The corresponding distances for a reduction to one one-thousandth of the original intensity (irrespective of the strength of the transmitter) are 58, 35, 30 and 20 meters, respectively. Since the conductivity of sea water is approximately one thousand times as great as that of fresh water, the absorption coefficients of salt water will all be approximately thirty times larger and the distances, for a given ratio of intensities, will be only 3 per cent. of those in fresh water.

It may be concluded: (1) that radio waves can not be expected in appreciable intensity at any great distance from *deeply* submerged undersea craft unless the transmitter has considerable power; (2) that the longer wave-lengths will travel farther than the shorter ones, other conditions being the same; and (3) that greater distances will be reached in fresh than in salt water.

A test was also made in which the receiver was placed near the water, on the shore, while the transmitter was submerged a short distance under the water and moved parallel to the shore line, away from the receiver. Intensity readings were taken every 20 meters up to a distance of 140 meters when the transmitter was brought to the shore and then carried back on the land toward the receiver. Intensity readings were made on the return trip and gave practically the same shape intensity-distance curve as on the outward journey, lying slightly above the water values. Similar results were obtained with the receiver in one boat and the transmitter in or below a second boat. An intensity-depth curve for 47.3 meter waves, for d from 0 to 2.6 meters, was made when the boats were 20 meters apart and yielded an absorption coefficient of 0.00260, in exact agreement (fortuitously) with the theoretical value.

The measurements in these latter tests were not made as carefully as those reported in the first part of this paper and, hence, can not be used with the same degree of conviction in drawing conclusions. We might assume, however, that the radio waves came to the surface within a comparatively short distance from the transmitter and, because of the comparatively high index of refraction of water (around 9, for these waves), were sharply refracted and traveled through the air to the receiver, rather than taking the shorter but much more absortive path directly through the water.

If these conclusions are valid, then it should be possible to signal to considerable distances from a submarine which is submerged only a *short* distance below the surface of the water.

The writer wishes to express his sincere thanks to Mr. M. Romberg for placing his power boat at our disposal and to the South Shore Power Boat Club for the use of its wharf and club house.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SPECTROCOLORIMETER FOR COMPARING THE SPECTRA OF SOLUTIONS OF DIFFERENT DEPTH[1]

IN matching colors and absorption bands it is desirable to have a simultaneous reference. A hand spectroscope mounted immediately above the prisms of a standard colorimeter of the Duboscq type provides two spectra in immediate juxtaposition when the adjustable slit of the spectroscope is placed perpendicular to the line of division of the two fields of light. This allows the instrument to be used as a regular colorimeter with the added advantage that specimens having an interfering color, such as urine- or bile-stained blood, can be more accurately matched and a correction made for the increased absorption of light by these interfering colors. A quick and accurate method is provided

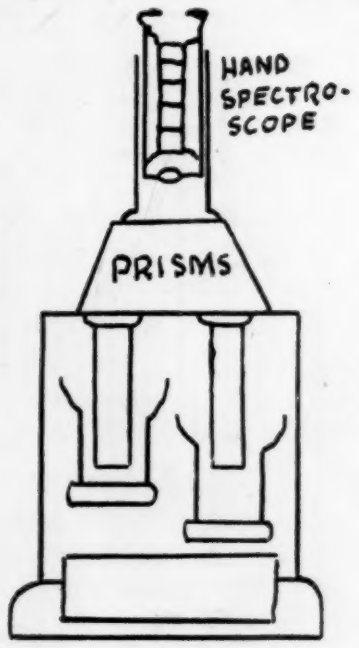

FIG. 1

[1] From the Littauer Pneumonia Research Fund, New York University College of Medicine, and the Medical Service, Harlem Hospital, Department of Hospitals, New York City, N. Y.

for identifying and determining the concentrations of substances having characteristic absorption bands, such as bilirubin, hematoporphyrin and methemoglobin.

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PERIODIC DISCHARGING OF LIQUIDS AND INTERMITTENT WASHING OF SOLIDS

A VERY efficient method of washing solids is an intermittent addition and draining of the solution. Also it is desirable in certain cases to add solution quickly for agitation but to drain slowly because of diffusion limitations from the surface or interior of the material being washed. Further, many substances such as shredded gels, being fragile, are partially lost in washing if agitation is done mechanically or by forcing gases through the bulk material.

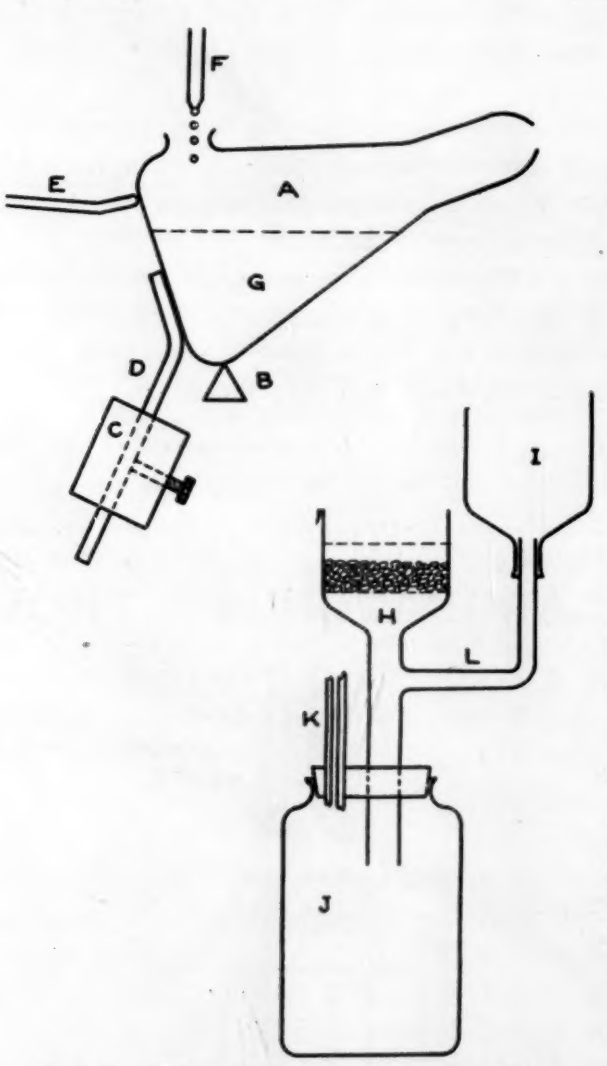

FIG. 1. Intermittent washing of solids.

We have devised a handy apparatus that can be set up in the laboratory. It is schematically shown in Fig. 1. A is merely an Erlenmeyer flask of appropriate dimensions with the mouth drawn down somewhat and a hole blown near the bottom. The flask rests on a fulcrum, B, and an adjustable weight, C, is attached to the flask by a rod D. B can include the holder for A, not shown in the diagram.

The sensitivity of the device depends on the unstable equilibrium, which in turn is influenced by the distance of the point of contact of the fulcrum from the center of gravity of the tilting flask containing liquid. With the appropriate dimensions the balance is maintained by moving C to the right position.

A stop bar, E, places the flask in the correct position for filling from a tube, F, and a slight adjustment of E also controls the amount of solution that will just dump. Obviously, the shape of the container is the cause of the mechanism shifting its center of gravity so that it functions on reaching a desired volume of wash solution. With a 500 cc flask the solution is delivered in 5 seconds.

The remainder of the figure is self-explanatory, H being a Buchner funnel and K a capillary that is adjustable. We have arranged that 500 cc drains in 3 minutes, while A fills in 5 minutes. The 111 mm inside diameter funnel will hold about 200 cc of material to be used. J is large enough to collect any sediment from the solid material so that K is not in danger of clogging.

The device is especially adaptable for washing such fragile material as shredded gelatin gels. The thinner the layer of material in the funnel the more uniform should be the washing. Funnels of larger diameter for the same weight of solid can be used for this purpose. No apparent difficulties are foreseen for making A any size desired.

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